This Page Is Inserted by IFW Operations
and is not a part of the Official Record

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images may include (but are not limited to):

- BLACK BORDERS
- TEXT CUT OFF AT TOP, BOTTOM OR SIDES
- FADED TEXT
- ILLEGIBLE TEXT
- SKEWED/SLANTED IMAGES
- COLORED PHOTOS
- BLACK OR VERY BLACK AND WHITE DARK PHOTOS
- GRAY SCALE DOCUMENTS

IMAGES ARE BEST AVAILABLE COPY.

As rescanning documents *will not* correct images, please do not report the images to the Image Problem Mailbox.

FIG. 1

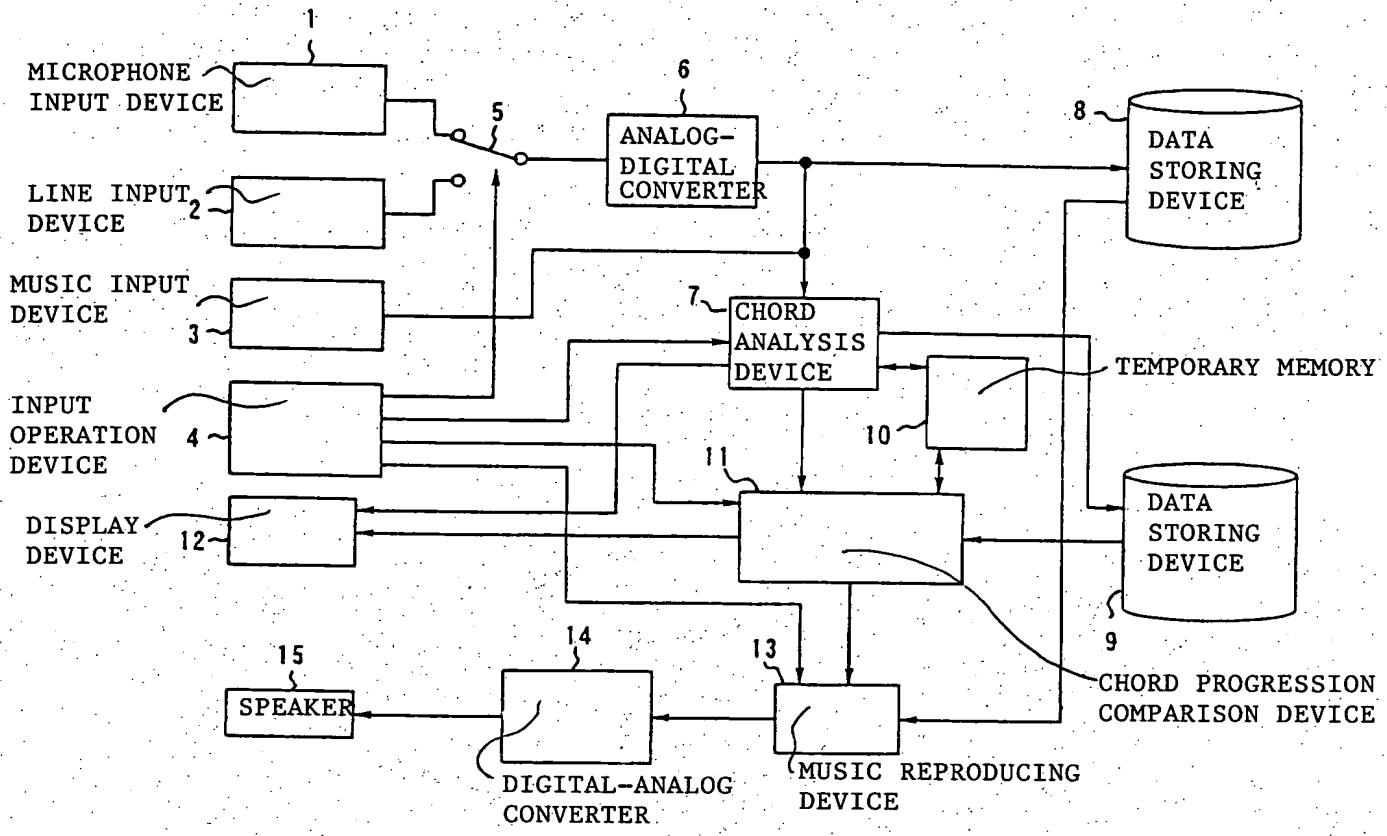

1
MICROPHONE INPUT DEVICE
LINE INPUT DEVICE
2
MUSIC INPUT DEVICE
3
INPUT OPERATION DEVICE
4
DISPLAY DEVICE
12
5
6
ANALOG-DIGITAL CONVERTER
8
DATA STORING DEVICE
7
CHORD ANALYSIS DEVICE
TEMPORARY MEMORY
10
11
DATA STORING DEVICE
9
CHORD PROGRESSION COMPARISON DEVICE
15
SPEAKER
14
DIGITAL-ANALOG CONVERTER
13
MUSIC REPRODUCING DEVICE

FIG. 2

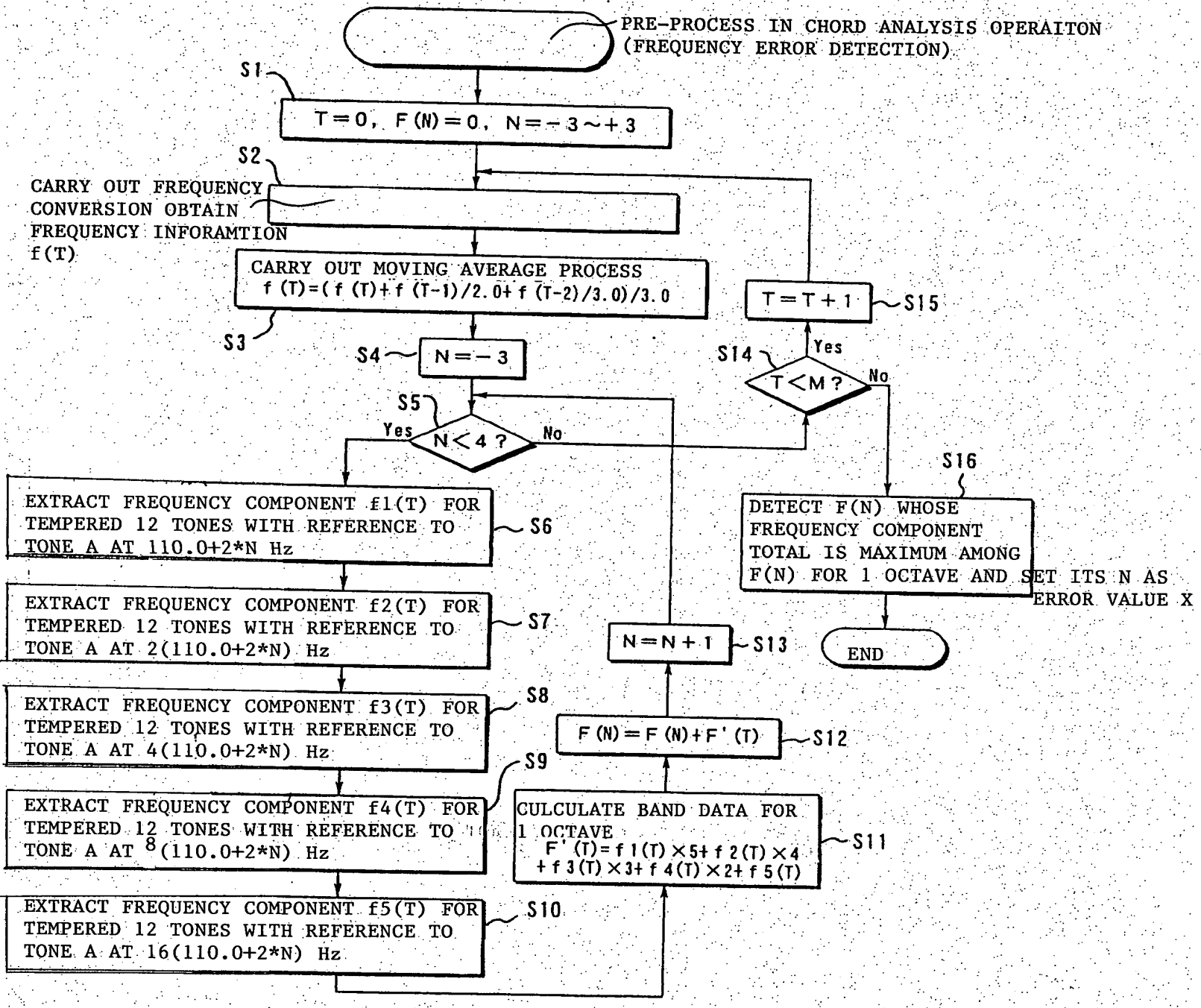

PRE-PROCESS IN CHORD ANALYSIS OPERAITON (FREQUENCY ERROR DETECTION)
S1
T=0, F(N)=0, N=-3~+3
S2
CARRY OUT FREQUENCY CONVERSION OBTAIN FREQUENCY INFORAMTION f(T)
CARRY OUT MOVING AVERAGE PROCESS f(T)=(f(T)+f(T-1)/2.0+f(T-2)/3.0)/3.0
S3
S4
N=-3
S5
Yes
N<4?
No
EXTRACT FREQUENCY COMPONENT f1(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 110.0+2*N Hz
S6
EXTRACT FREQUENCY COMPONENT f2(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 2(110.0+2*N) Hz
S7
EXTRACT FREQUENCY COMPONENT f3(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 4(110.0+2*N) Hz
S8
EXTRACT FREQUENCY COMPONENT f4(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 8(110.0+2*N) Hz
S9
EXTRACT FREQUENCY COMPONENT f5(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 16(110.0+2*N) Hz
S10
CULCULATE BAND DATA FOR 1 OCTAVE
F'(T)=f1(T)×5+f2(T)×4+f3(T)×3+f4(T)×2+f5(T)
S11
F(N)=F(N)+F'(T)
S12
N=N+1
S13
S14
T<M?
Yes
No
T=T+1
S15
S16
DETECT F(N) WHOSE FREQUENCY COMPONENT TOTAL IS MAXIMUM AMONG F(N) FOR 1 OCTAVE AND SET ITS N AS ERROR VALUE X
END

FIG. 3

A	1.0
A#	AX1.059163
B	AX1.124622
C	AX1.189207
C#	AX1.259921
D	AX1.334840
D#	AX1.414214
E	AX1.498307
F	AX1.587401
F#	AX1.681793
G	AX1.781797
G#	AX1.887749
A	AX2.0

FIG. 4

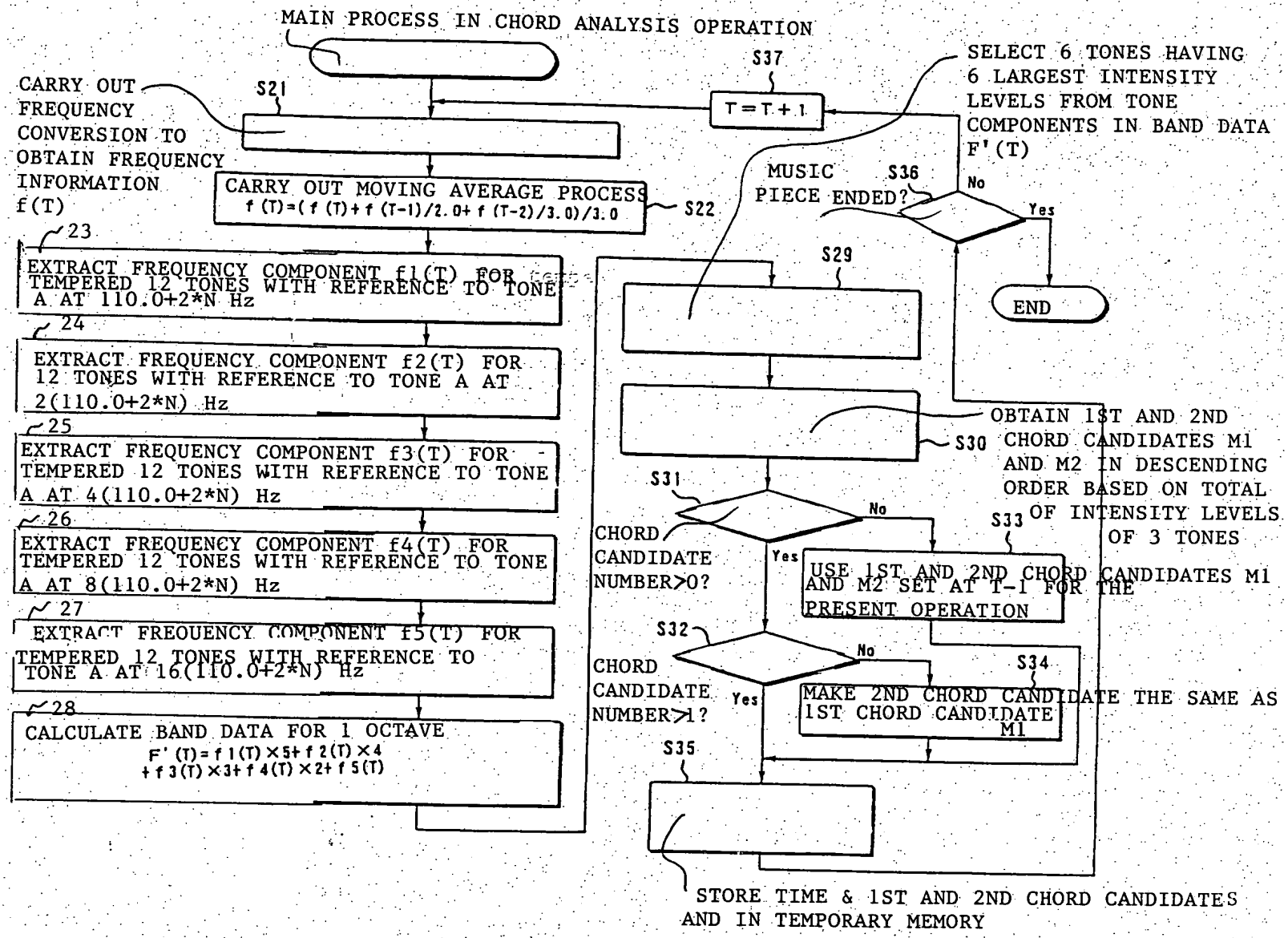

MAIN PROCESS IN CHORD ANALYSIS OPERATION
CARRY OUT FREQUENCY CONVERSION TO OBTAIN FREQUENCY INFORMATION f(T)
S21
CARRY OUT MOVING AVERAGE PROCESS
f(T)=(f(T)+f(T-1)/2.0+f(T-2)/3.0)/3.0
S22
23
EXTRACT FREQUENCY COMPONENT f1(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 110.0+2*N Hz
24
EXTRACT FREQUENCY COMPONENT f2(T) FOR 12 TONES WITH REFERENCE TO TONE A AT 2(110.0+2*N) Hz
25
EXTRACT FREQUENCY COMPONENT f3(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 4(110.0+2*N) Hz
26
EXTRACT FREQUENCY COMPONENT f4(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 8(110.0+2*N) Hz
27
EXTRACT FREQUENCY COMPONENT f5(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 16(110.0+2*N) Hz
28
CALCULATE BAND DATA FOR 1 OCTAVE
F'(T)=f1(T)×5+f2(T)×4+f3(T)×3+f4(T)×2+f5(T)
S29
S30
OBTAIN 1ST AND 2ND CHORD CANDIDATES M1 AND M2 IN DESCENDING ORDER BASED ON TOTAL OF INTENSITY LEVELS OF 3 TONES
S31
CHORD CANDIDATE NUMBER>0?
No
Yes
S33
USE 1ST AND 2ND CHORD CANDIDATES M1 AND M2 SET AT T-1 FOR THE PRESENT OPERATION
S32
CHORD CANDIDATE NUMBER>1?
No
Yes
S34
MAKE 2ND CHORD CANDIDATE THE SAME AS 1ST CHORD CANDIDATE M1
S35
STORE TIME & 1ST AND 2ND CHORD CANDIDATES AND IN TEMPORARY MEMORY
S36
MUSIC PIECE ENDED?
No
Yes
END
S37
T=T+1
SELECT 6 TONES HAVING 6 LARGEST INTENSITY LEVELS FROM TONE COMPONENTS IN BAND DATA F'(T)

FIG. 5

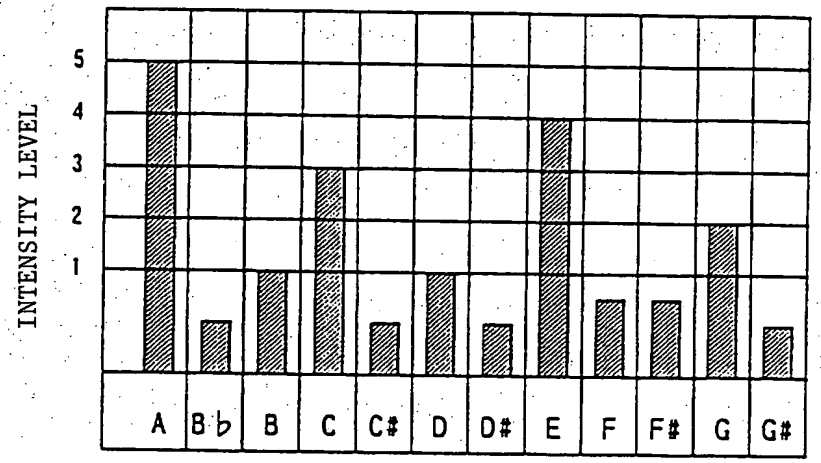

INTENSITY LEVEL
5
4
3
2
1
A
B♭
B
C
C#
D
D#
E
F
F#
G
G#

FIG. 6

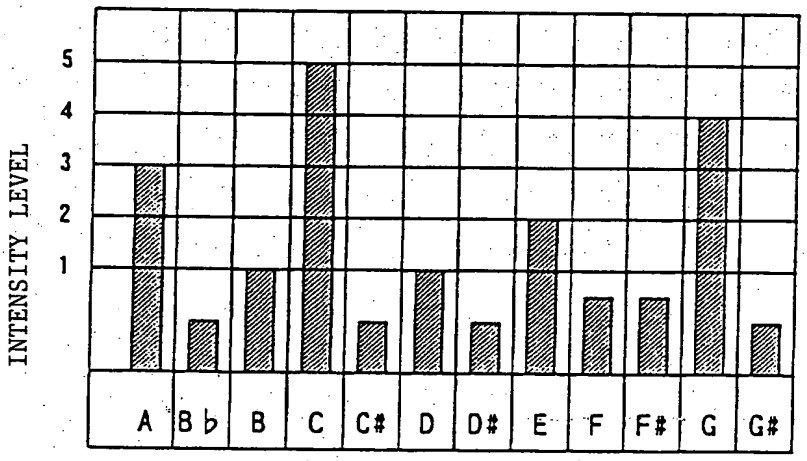

INTENSITY LEVEL
5
4
3
2
1
A
B♭
B
C
C#
D
D#
E
F
F#
G
G#

FIG. 7

A+C+E+G(Am7)
→ A+C+E(Am) | C+E+G(C)
A+C+E♭+F#(Adim7)
→ A+C+E♭(Adim7^{CANDIDATE}) | C+E♭+F#(Cdim7^{CANDIDATE})
A+C#+E+G(A7)
→A+C#+E(A) | A+C#+G(A7$^{CANDIDATE}_{DATE}$) | C#+E+G(C#dim7^{CANDIDATE})
A+C+E+G+B(Am7.9)
→A+C+E(Am) | C+E+G(C) | E+G+B(Em)

FIG. 8

TIME (4 BYTES) 1ST CHORD CANDIDATE (1BYTE) 2ND CHORD CANDIDATE (1 BYTE)
TIME (4 BYTES) 1ST CHORD CANDIDATE (1 BYTE) 2ND CHORD CANDIDATE (1 BYTE)

⋮

TIME (4 BYTE) 1ST CHORD CANDIDATE (1 BYTE) 2ND CHORD CANDIDATE (1 BYTE)

FIG. 9A

FUNDAMENTAL TONE	
A	0x00
A#	0x01
B	0x02
C	0x03
C#	0x04
D	0x05
D#	0x06
E	0x07
F	0x08
F#	0x09
G	0x0A
G#	0x0B

FIG. 9B

ATTRIBUTE	
MAJOR	0x00
MINOR	0x02
7TH CANDIDATE	0x01
DIM 7TH CANDIDATE	0x03

FIG. 9C

ATTRIBUTE (LOWER 4 BITS) +
FUNDAMENTAL TONE (LOWER 4 BITS)

~~EP01-03042~~

FIG. 10

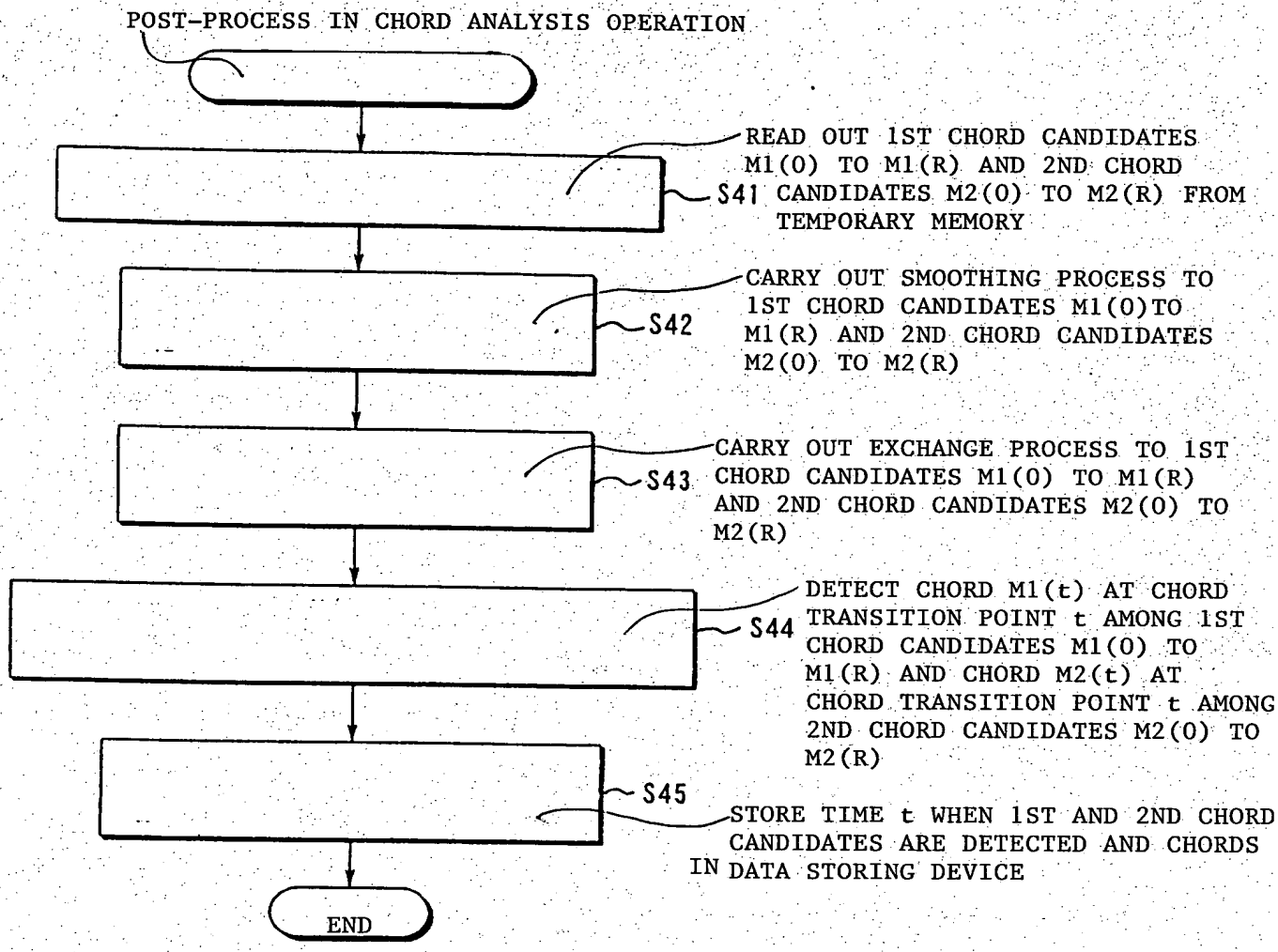


FIG. 11

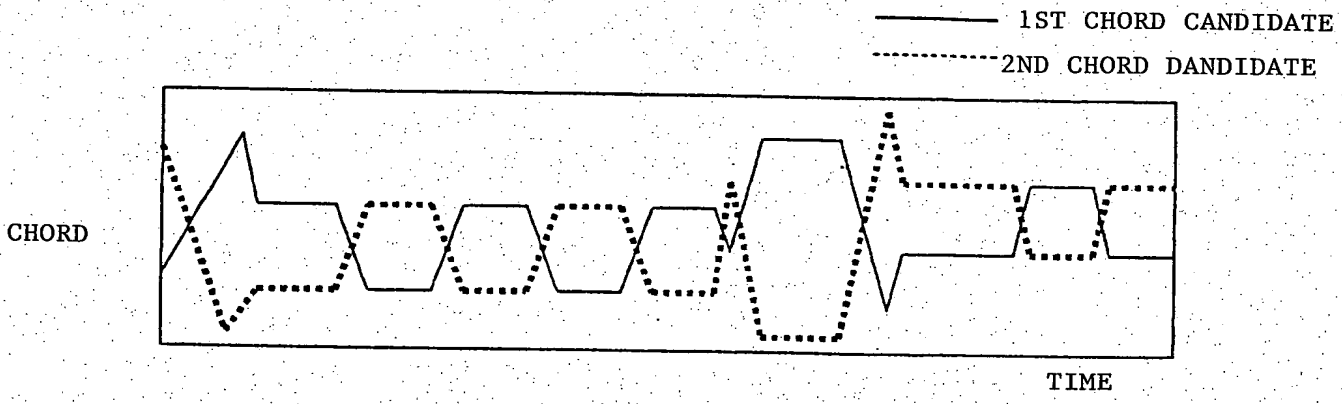


FIG. 12

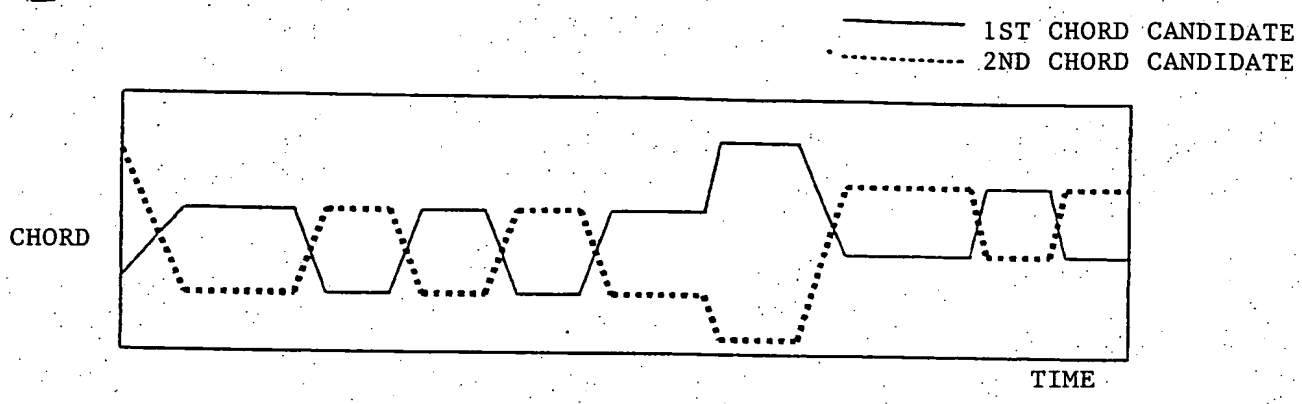

1ST CHORD CANDIDATE
2ND CHORD CANDIDATE
CHORD
TIME

FIG. 13

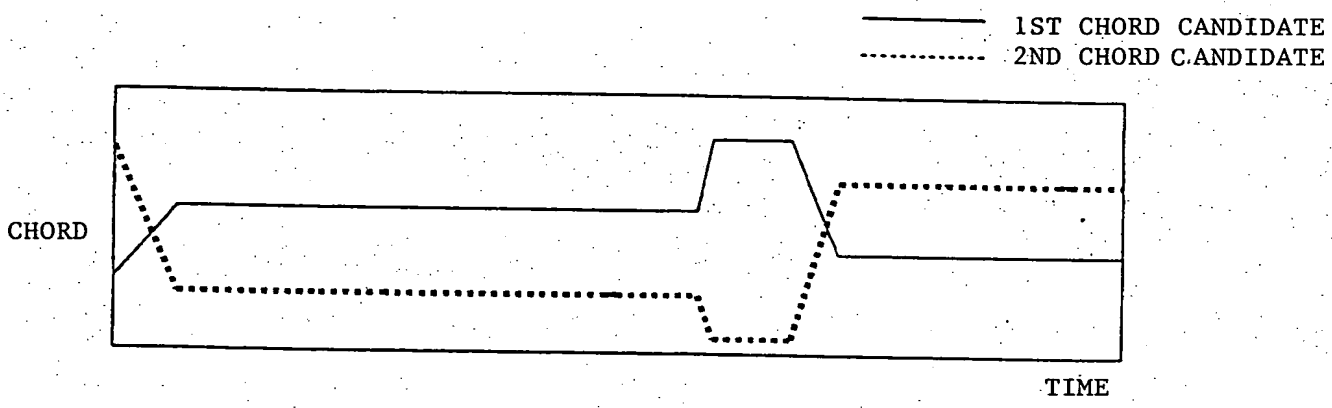

1ST CHORD CANDIDATE
2ND CHORD CANDIDATE
CHORD
TIME

FIG.14A

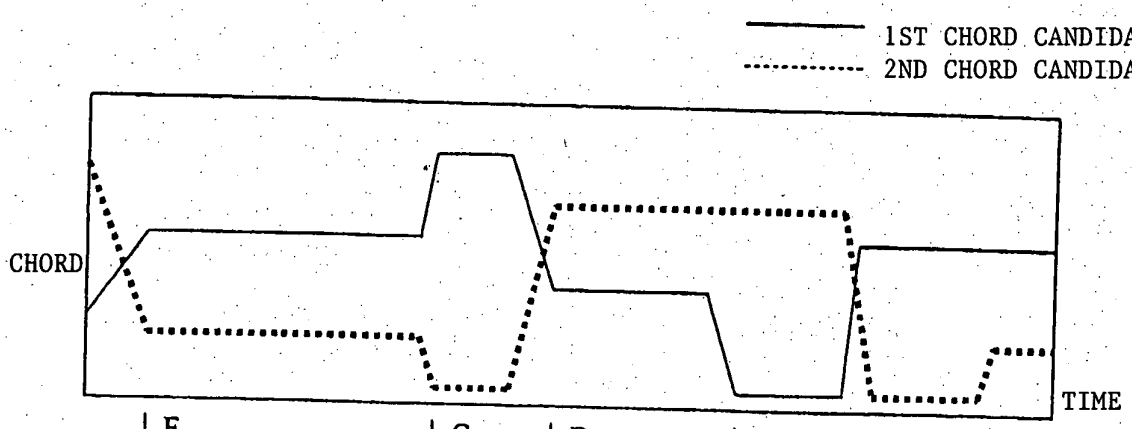


FIG. 14B

TRANSITION OF 1ST CHORD CANDIDATE									
	F		G		D		B♭		F
	0x08		0x0A		0x05)		0x01		0x08
←TIME	(T1(0))		T1(1)		T1(2)		T1(3)		T1(4)

FIG.14C

TRANSITION OF 2ND CHORD CANDIDATE									
	C		B♭		F#m			B♭	C
	0x03		0x01		0x29			0x01	0x03
←TIME	(T2(0))		T2(1)		T2(2)			T2(3)	T2(4)

FIG. 14D

INDENTIFICATION INFORMATION FOR MUSIC PIECES(FILE NAMES, ETC.) (512 BYTES)

NUMBER OF 1ST CHORD CANDIDATES (4 BYTES) T1(0) (4 BYTES)[0x08] T1(1) (4 BYTES)[0x0A] T1(2) (4 BYTES)[0x05] T1(3) (4 BYTES)[0x01] T1(4) (4 BYTES)[0x08].....

NUMBER OF 2ND CHORD CANDIDATES(4BYTES) T2(0) (4BYTES)[0x03] T2(1) (4BYTES)[0x01] T2(2) (4BYTES)[0x29] T2(3) (4BYTES)[0x01] T2(4) (4 BYTES)[0x03].....

FIG. 15

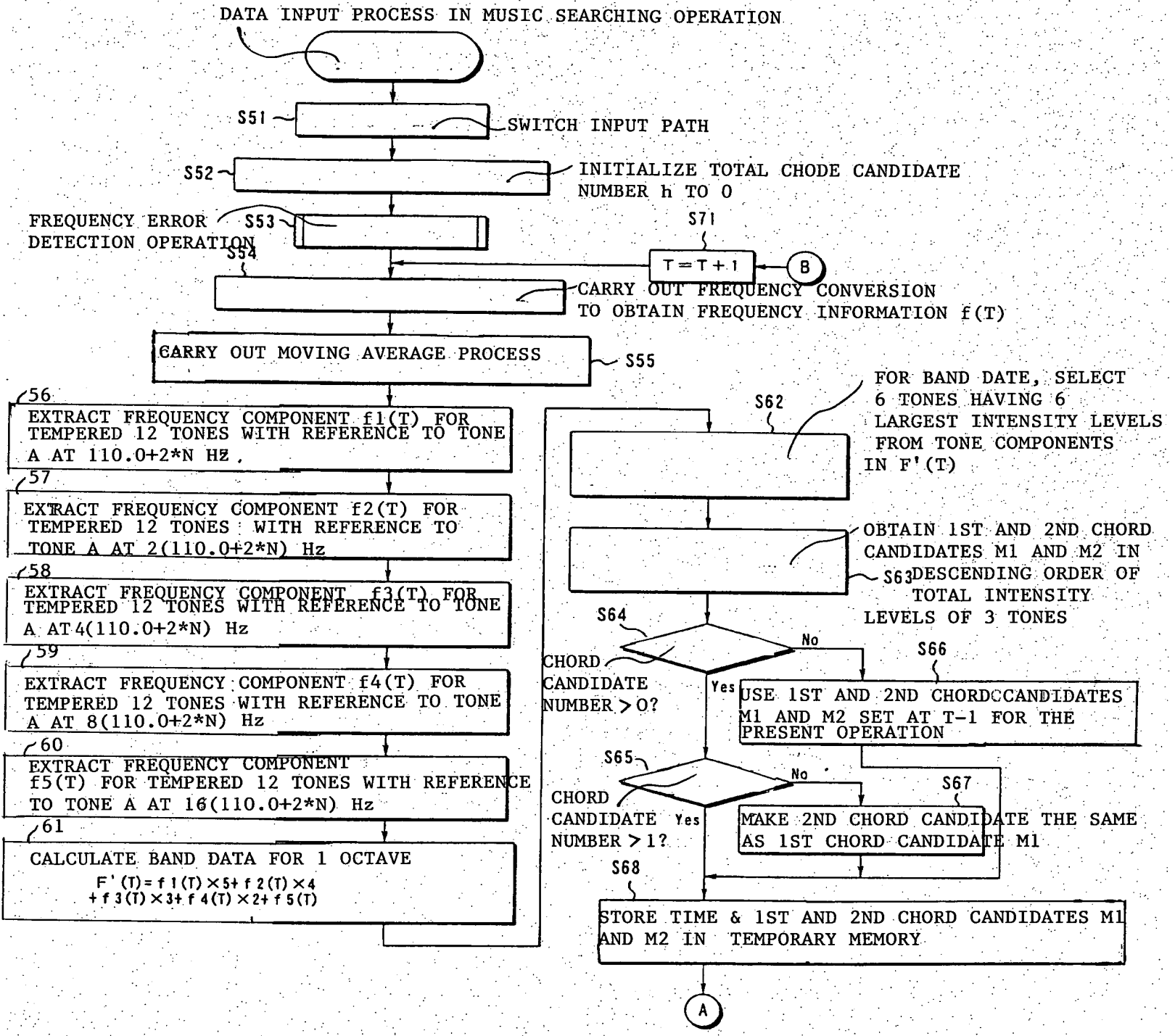

DATA INPUT PROCESS IN MUSIC SEARCHING OPERATION
S51
SWITCH INPUT PATH
S52
INITIALIZE TOTAL CHODE CANDIDATE NUMBER h TO 0
FREQUENCY ERROR DETECTION OPERATION
S53
S71
T=T+1
B
S54
CARRY OUT FREQUENCY CONVERSION TO OBTAIN FREQUENCY INFORMATION f(T)
CARRY OUT MOVING AVERAGE PROCESS
S55
56
EXTRACT FREQUENCY COMPONENT f1(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 110.0+2*N HZ.
57
EXTRACT FREQUENCY COMPONENT f2(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 2(110.0+2*N) Hz
58
EXTRACT FREQUENCY COMPONENT f3(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 4(110.0+2*N) Hz
59
EXTRACT FREQUENCY COMPONENT f4(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 8(110.0+2*N) Hz
60
EXTRACT FREQUENCY COMPONENT f5(T) FOR TEMPERED 12 TONES WITH REFERENCE TO TONE A AT 16(110.0+2*N) Hz
61
CALCULATE BAND DATA FOR 1 OCTAVE
F'(T)=f1(T)×5+f2(T)×4 +f3(T)×3+f4(T)×2+f5(T)
S62
FOR BAND DATE, SELECT 6 TONES HAVING 6 LARGEST INTENSITY LEVELS FROM TONE COMPONENTS IN F'(T)
OBTAIN 1ST AND 2ND CHORD CANDIDATES M1 AND M2 IN DESCENDING ORDER OF TOTAL INTENSITY LEVELS OF 3 TONES
S63
S64
CHORD CANDIDATE NUMBER > 0?
No
Yes
S66
USE 1ST AND 2ND CHORDCCANDIDATES M1 AND M2 SET AT T-1 FOR THE PRESENT OPERATION
S65
CHORD CANDIDATE NUMBER > 1?
No
Yes
S67
MAKE 2ND CHORD CANDIDATE THE SAME AS 1ST CHORD CANDIDATE M1
S68
STORE TIME & 1ST AND 2ND CHORD CANDIDATES M1 AND M2 IN TEMPORARY MEMORY
A

FIG. 16

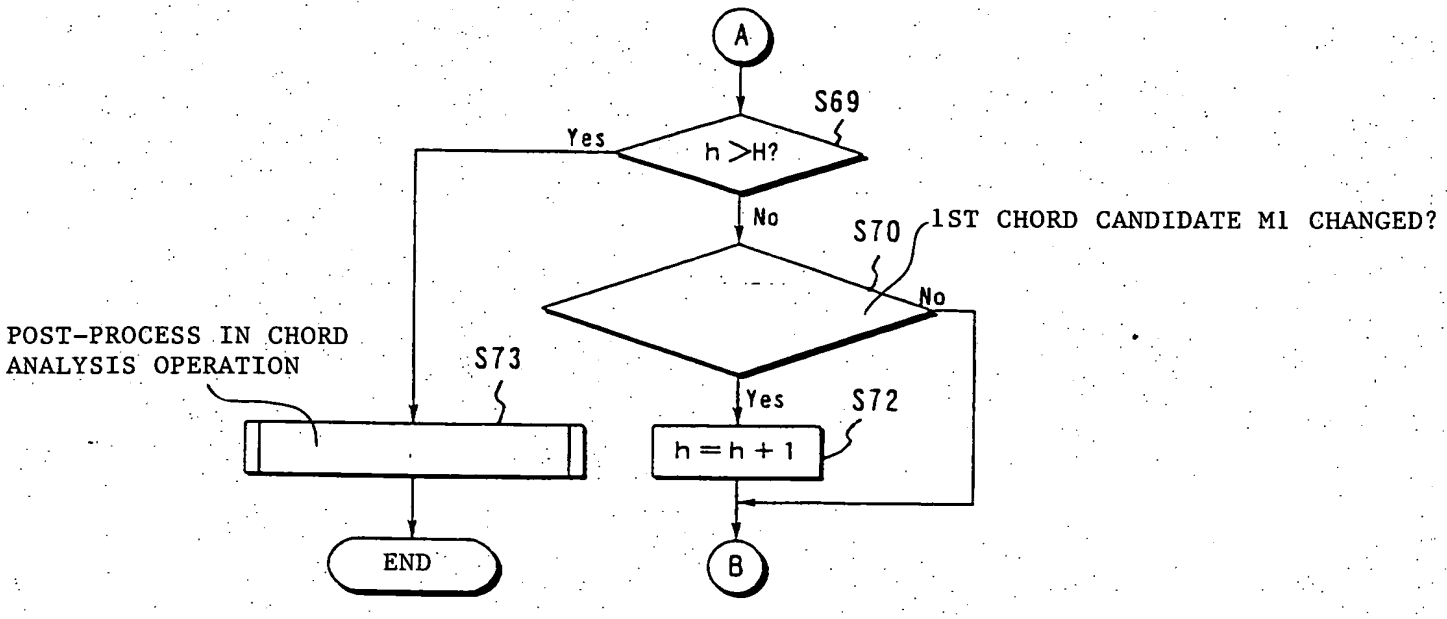

A
S69
h > H?
Yes
No
S70
1ST CHORD CANDIDATE M1 CHANGED?
No
Yes
S72
h = h + 1
POST-PROCESS IN CHORD ANALYSIS OPERATION
S73
END
B

FIG. 17

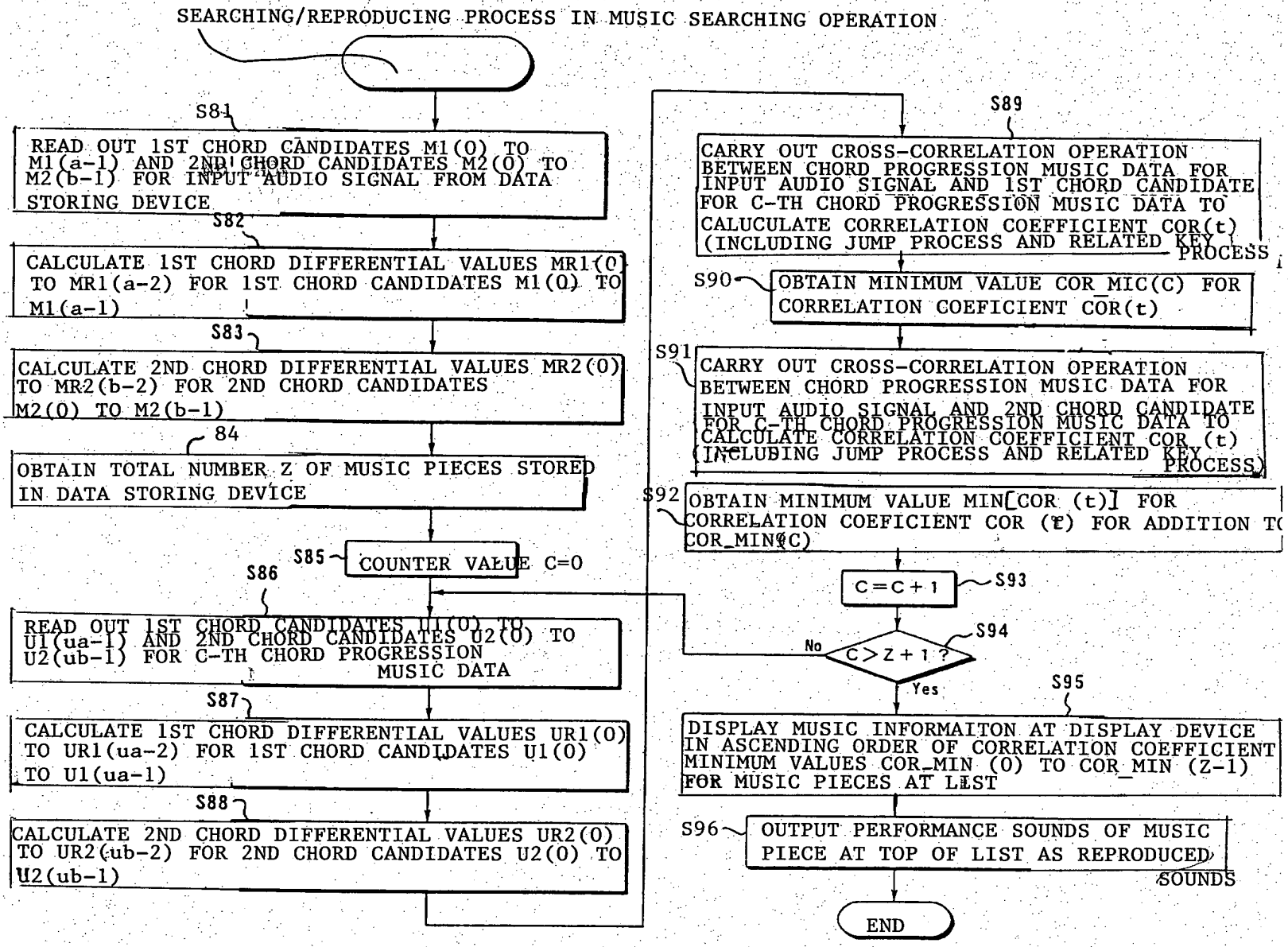

SEARCHING/REPRODUCING PROCESS IN MUSIC SEARCHING OPERATION
S81
READ OUT 1ST CHORD CANDIDATES M1(0) TO M1(a-1) AND 2ND CHORD CANDIDATES M2(0) TO M2(b-1) FOR INPUT AUDIO SIGNAL FROM DATA STORING DEVICE
S82
CALCULATE 1ST CHORD DIFFERENTIAL VALUES MR1(0) TO MR1(a-2) FOR 1ST CHORD CANDIDATES M1(0) TO M1(a-1)
S83
CALCULATE 2ND CHORD DIFFERENTIAL VALUES MR2(0) TO MR2(b-2) FOR 2ND CHORD CANDIDATES M2(0) TO M2(b-1)
84
OBTAIN TOTAL NUMBER Z OF MUSIC PIECES STORED IN DATA STORING DEVICE
S85
COUNTER VALUE C=0
S86
READ OUT 1ST CHORD CANDIDATES U1(0) TO U1(ua-1) AND 2ND CHORD CANDIDATES U2(0) TO U2(ub-1) FOR C-TH CHORD PROGRESSION MUSIC DATA
S87
CALCULATE 1ST CHORD DIFFERENTIAL VALUES UR1(0) TO UR1(ua-2) FOR 1ST CHORD CANDIDATES U1(0) TO U1(ua-1)
S88
CALCULATE 2ND CHORD DIFFERENTIAL VALUES UR2(0) TO UR2(ub-2) FOR 2ND CHORD CANDIDATES U2(0) TO U2(ub-1)
S89
CARRY OUT CROSS-CORRELATION OPERATION BETWEEN CHORD PROGRESSION MUSIC DATA FOR INPUT AUDIO SIGNAL AND 1ST CHORD CANDIDATE FOR C-TH CHORD PROGRESSION MUSIC DATA TO CALUCULATE CORRELATION COEFFICIENT COR(t) (INCLUDING JUMP PROCESS AND RELATED KEY PROCESS
S90
OBTAIN MINIMUM VALUE COR_MIC(C) FOR CORRELATION COEFICIENT COR(t)
S91
CARRY OUT CROSS-CORRELATION OPERATION BETWEEN CHORD PROGRESSION MUSIC DATA FOR INPUT AUDIO SIGNAL AND 2ND CHORD CANDIDATE FOR C-TH CHORD PROGRESSION MUSIC DATA TO CALCULATE CORRELATION COEFFICIENT COR (t) (INCLUDING JUMP PROCESS AND RELATED KEY PROCESS)
S92
OBTAIN MINIMUM VALUE MIN[COR (t)] FOR CORRELATION COEFICIENT COR (t) FOR ADDITION TO COR_MIN(C)
S93
C=C+1
S94
No
C>Z+1 ?
Yes
S95
DISPLAY MUSIC INFORMAITON AT DISPLAY DEVICE IN ASCENDING ORDER OF CORRELATION COEFFICIENT MINIMUM VALUES COR_MIN (0) TO COR_MIN (Z-1) FOR MUSIC PIECES AT LIST
S96
OUTPUT PERFORMANCE SOUNDS OF MUSIC PIECE AT TOP OF LIST AS REPRODUCED SOUNDS
END

FIG. 18

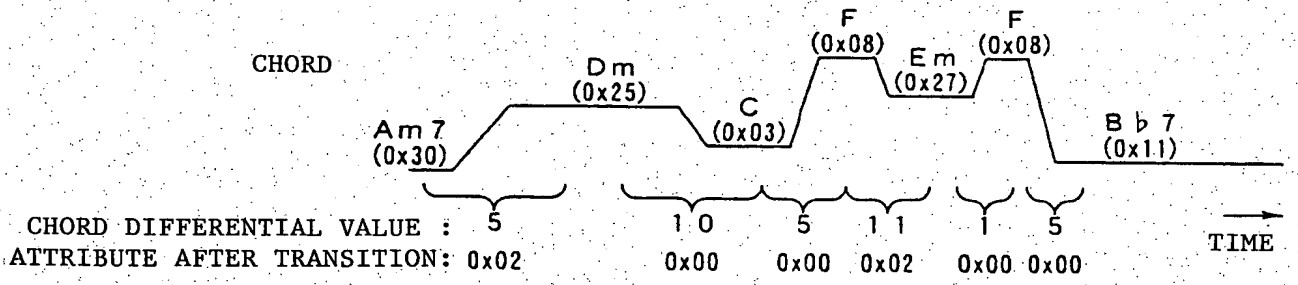

CHORD
Am7 (0x30)
Dm (0x25)
C (0x03)
F (0x08)
Em (0x27)
F (0x08)
B♭7 (0x11)
CHORD DIFFERENTIAL VALUE : 5 10 5 11 1 5
ATTRIBUTE AFTER TRANSITION: 0x02 0x00 0x00 0x02 0x00 0x00
TIME

FIG.19A

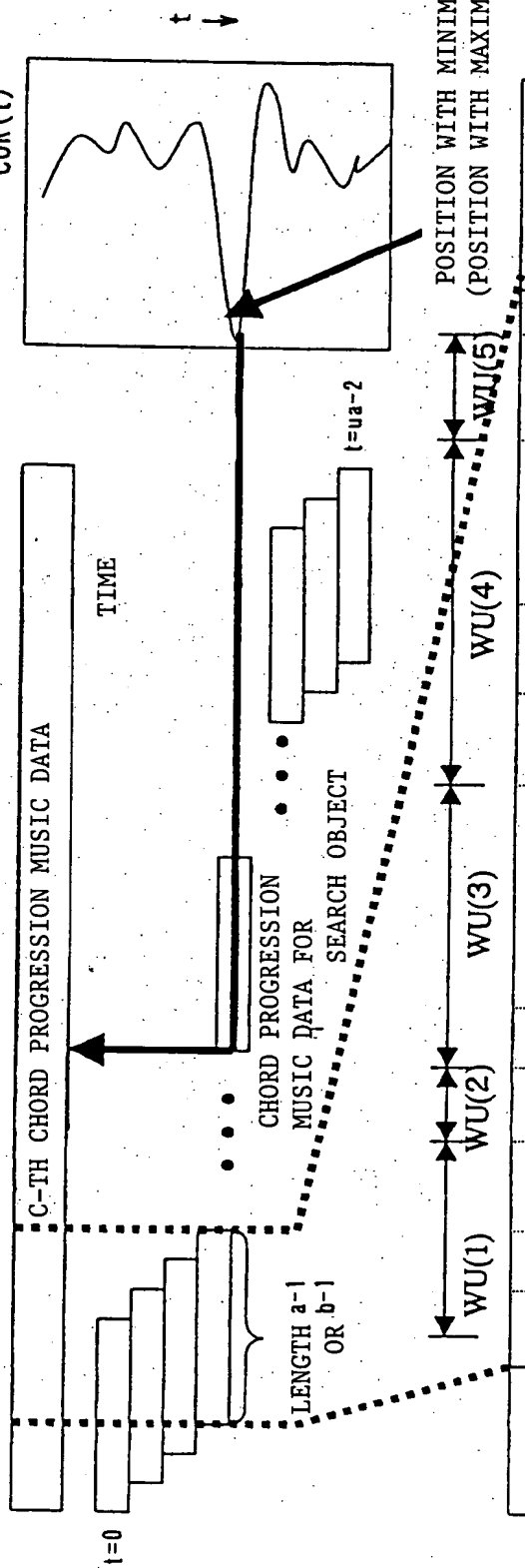


FIG.19B

FIG.19C

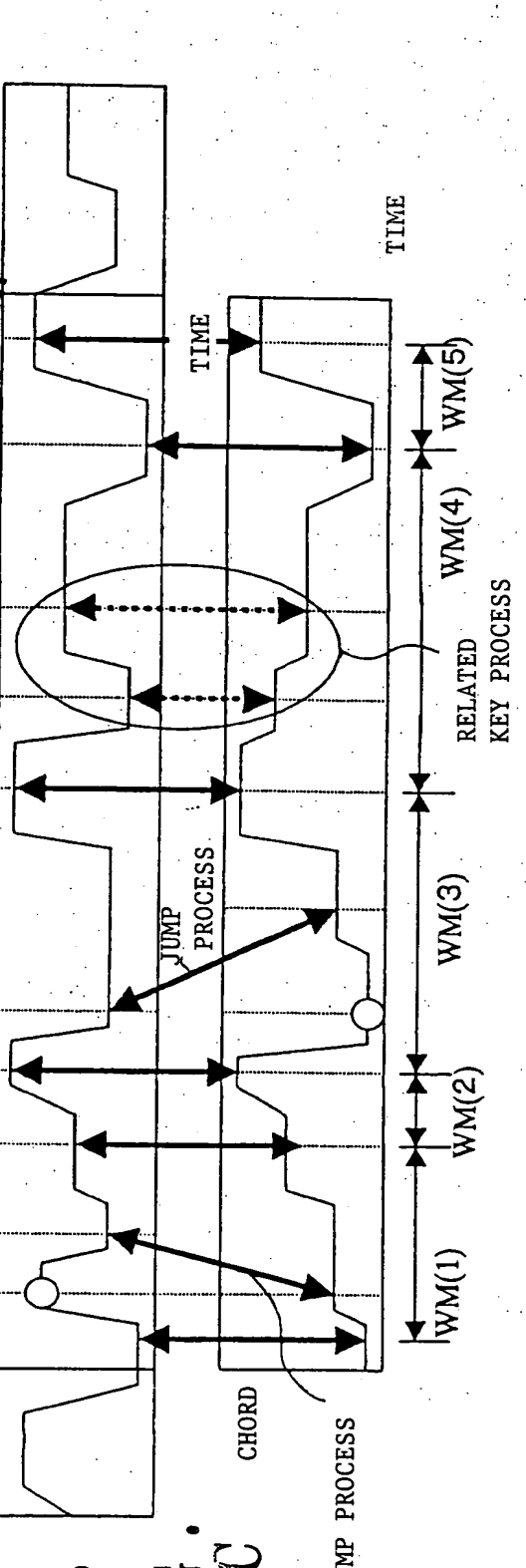
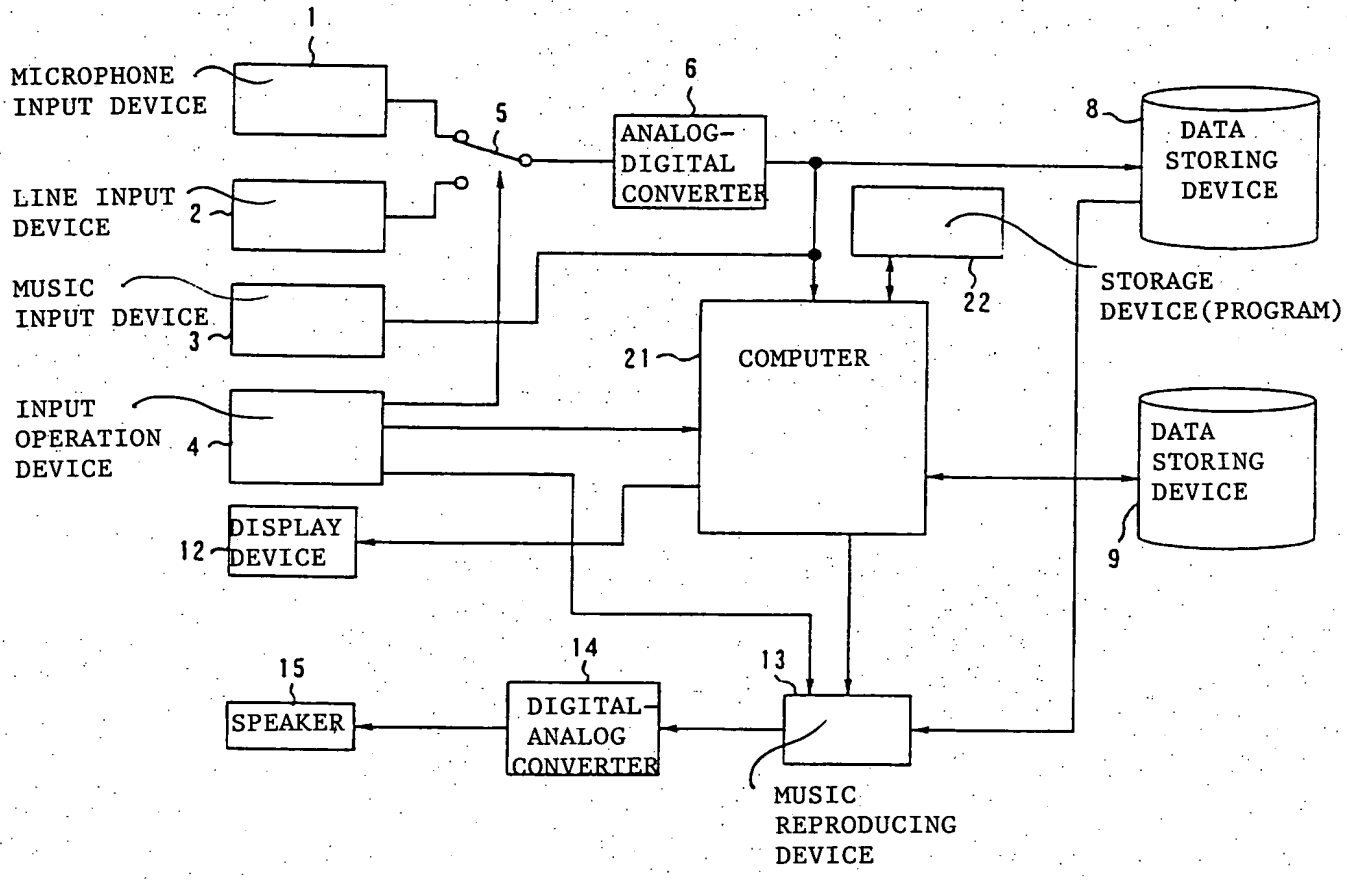


FIG. 20


1
MICROPHONE INPUT DEVICE
6
ANALOG-DIGITAL CONVERTER
5
8
DATA STORING DEVICE
LINE INPUT DEVICE
2
MUSIC INPUT DEVICE
3
22
STORAGE DEVICE(PROGRAM)
21
COMPUTER
INPUT OPERATION DEVICE
4
DATA STORING DEVICE
9
DISPLAY DEVICE
12
14
13
15
SPEAKER
DIGITAL-ANALOG CONVERTER
MUSIC REPRODUCING DEVICE